

April 2025
END OF TERM 1 EXAMINATIONS
S5 CHEMISTRY Theory
Paper 1
2 hours

INSTRUCTIONS TO CANDIDATES

- Attempt any four items in this paper.
- Write your responses **only** on the answer sheets provided.
- Begin responding to each item on a fresh page.
- A graph paper is provided use it if required.

Item 1

It has been established by the physical sciences that some elements like sodium have identical atoms of mass 23u in nature while others like magnesium and lithium do not. Those of magnesium have mass, 23.99u, 24.99u and 25.98u and occur in a natural sample at rates of 78.99%, 10.00% and 11.01% respectively. The average atomic mass of lithium is 6.94 and its atoms have masses of 6u and 7u.

To Nahabwe Justine, a new comer to your class, this poses a problem in her understanding. She wonders (i) how does it happen that an element can have different atoms and (ii) how then can the mass of one atom of an element with different atoms be worked out. She also insists that in a natural sample, all atoms whether identical or not must occur at the same rate.

Task

As a student of Chemistry help Justine understand,

- a) The type of phenomenon when and why some elements have identical atoms while others do not.
- b) How the average atomic mass of an element can be worked from the atomic masses of its atoms. Use an example.
- c) That she is not true in claiming that different atoms of an element must occur in equal amounts in a natural sample of the element. Use an example.

Item 2

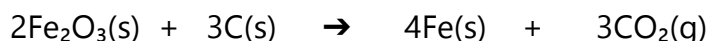
A new comer to S5 attempted to write the electronic configuration of bromine (atomic number 35). They wrote it down as 2:8:8:8:1 and were immediately confused. Interpretation of this configuration puts bromine in group I and in period 6 of the Periodic Table. This is clearly not true.

Task

Help the new comer understand the more acceptable way of writing electronic configurations how these can be used to position elements in the Periodic Table.

Item 3

A factory uses charcoal that comes in 65kg bags each at 65000 UgX in smelting process to produce iron. The reaction occurs as below:



A procurement and accounts planning officer has come to you from the factory with a problem. They need your help. They need an estimate on how much it will cost in charcoal to produce 150 tonnes of iron and how much they will pay in environmental protection tax if the rate is 78000 per tonne of carbon dioxide released into the atmosphere.

(Take atomic masses Fe = 56, C = 12 and O = 16)

Task

With clear working, provide answers to the officer from the factory. (Assume the charcoal is 100% carbon)

Item 4

An oil pipeline engineer made a mistake while attempting to locate a leak on an oil pipeline. He accidentally added 78g of radioactive substance at a pumping station. This set off alarms indicating the levels of radioactivity in the oil were very dangerous. The pipe had to be shut down. The facility and the nearby community was vacated due to the dangerously high levels of radiation.

The environmental authorities then set up meters that measured the levels of radioactivity in the area.

They got the data below:

Time (days)	0	10	20	30	40	50
Activity (counts per second)	21	8.9	3.8	1.6	0.7	0.3

The government is claiming that the area will be safe again if the amount of the radioactive substance in the oil reduces to 5% and that this will happen in two weeks.

Task

As a student of Chemistry and showing clear working, using the information provided, respond to the claims of the government.

Item 5

A researcher has been given an organic compound **Q** and been tasked with determining how much carbon dioxide will be released into the atmosphere when the substance burns. They have provided with the information below:

Q consists of 81.818% carbon, by mass the rest being hydrogen.

Analysis of Q in a mass spectrometer gives a molecular ion peak at $m/z = 44$.

The researcher is very skeptical about the value 44. They do not understand how it is got.

Tasks

As a learner of Chemistry help

- a) The researcher understand how the value 44 is got by an analytical method.
- b) Determine how much carbon dioxide is released into the atmosphere when a kilogram of Q is burnt in air completely. (Take C = 12 and H = 1)

END